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ESSO TUTU SERVICE STATION  
SOIL VAPOR INVESTIGATION PLAN

Prepared for:

Department of Planning & Natural Resources, USVI.  
Environmental Protection Agency - Region II, N.Y.  
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Submitted by  
Esso Standard Oil S.A. Ltd.

*Carlos M. Belgodere*

Carlos M. Belgodere, Belgodere & Associates Inc.  
Project Coordinator.

*Ana Gloria Ramos*

Ana Gloria Ramos, P.E., ESSO Standard Oil SA LTD.  
Project Manager

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## 1.0 Description of Work

### 1.1 Background

A number of water wells have been shut down by the Department of Planning and Natural Resources of the USVI (DPNR) and the Environmental Protection Agency Region II, New York (EPA) as a result of reported ground water contamination in the Tutu area of St. Thomas, USVI. DPNR/EPA believe that among the possible sources of hydrocarbon contamination found in the ground water may be one or more of the various gasoline service stations which operate or had operated in the Tutu area. Esso Standard Oil S. A. Ltd. (ESSO) is the owner of the gasoline service station located in the Four Winds Shopping Center at the Tutu Area of St. Thomas. In consideration thereof, DPNR has ordered ESSO to submit an investigation plan to assess the potential seepage of product into the underlying soil of the above referred Service Station.

ESSO has requested Belgodere & Associates Inc. (BAI) to perform the above mentioned investigation ordered by DPNR. Pursuant to DPNR Administrative Order of September 17, 1987, the plan contained herein has been developed to effectively characterize the contaminants, if any, at the soils beneath the Service Station.

The study will encompass an assessment of the possibility of motor fuel releases from underground storage tanks/pipelines and potential migration pathways at the Esso Service Station by performing a soil vapor survey. If as a result of the soil vapor investigation it is determined that the Esso Service Station is not the source nor has contributed to the contamination of the

local aquifers, adequate releases in agreement with DFNR/EPA will be sought by Esso Standard Oil S.A. Ltd.

ESSO, and BAI Representatives have met with EPA Project Manager, Ms. Caroline Kwan, DFNR Representative, Ms. Francine Lang, and the Project Officer at Camp, Dresser & McKee Federal Programs Corporation (CDM-FPC) Mr. Scott E. Graber. DFNR, EPA, and CDM-FPC have discussed the principles for the technical approach and work schedule presented in this Work Plan. It is our understanding that all parties are in agreement with the concepts and schedule presented herein.

## 1.2 Hydrogeologic Setting

The Esso Service Station is located in St. Thomas U.S.V.I., on the West Side of Rd #38 in the Tutu area, at the Four Winds Shopping Center Parking Lot.

According to information obtained from "Soil Survey Virgin Islands of the US, 1970 Soil Conservation Service Report", issued in August 1970, the area is described as a network of terraces and alluvial fans sloping gently to moderately toward the south. Soil deposits consist of stratified sands, gravels and clays with a permeability of 0.20 to 0.63 in./hr. Soil strata thickness around site location varies from bare rock on slope side of hills to over 20 ft. on alluvial deposits.

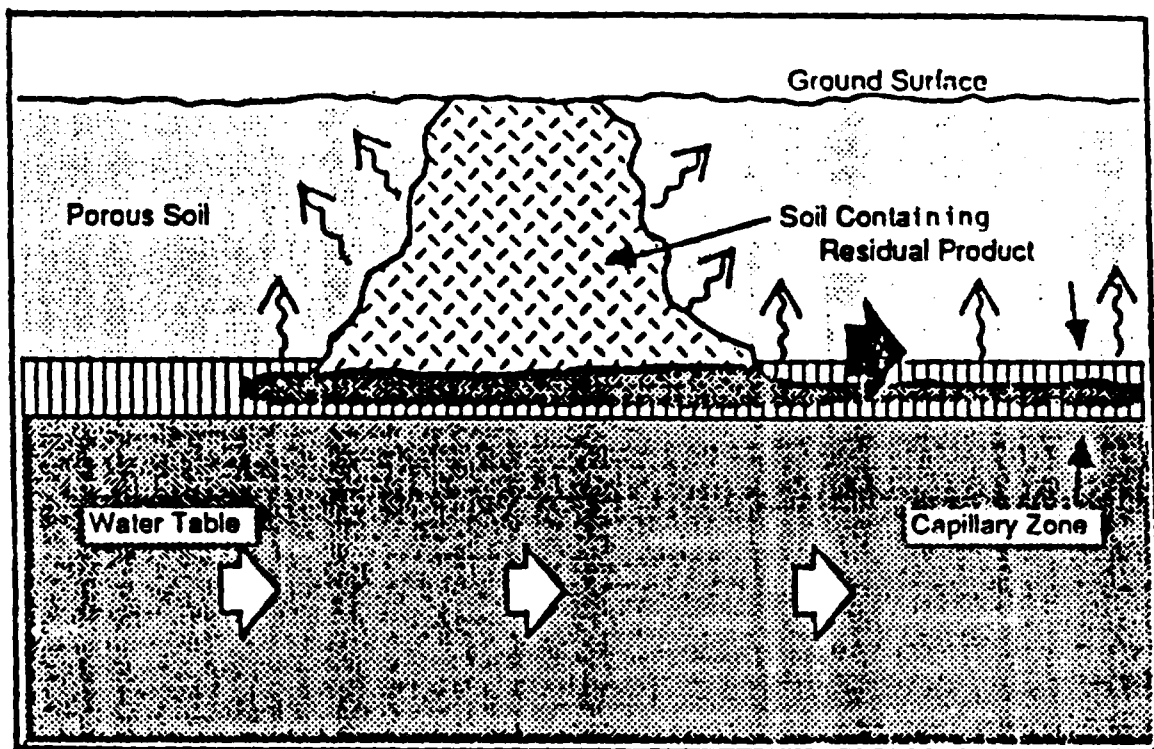
Based on topographic and structural information obtained from "Geology of St. Thomas and St. John, U.S. Virgin Islands" by Thomas W. Donnelly (NSF, G-114407) the local water table should generally slope to the south. Direction of local ground water flow is controlled by volcanic bedrock fractures underlying the


Based on discussion with local water well drillers (Poly Caribe) depth, of ground water at the Four Winds Shopping Center well, located 25 ft. north of the Service Station and the Tillett Water Well, located 250 ft. north east, is reported to be between 15 and 20 ft. during the rainy seasons where water table is high and pumping of commercial and residential water wells is low. The local aquifer water table has been previously observed beyond 80 ft. as a result of high water extraction during extended drought periods.

### 1.3 Purpose and Methodology of Soil Vapor Survey.

The purpose of the proposed soil vapor survey is to determine whether there has been a leak or a spill from the Service Station underground storage tanks and/or pipelines that may have contributed to the local aquifer contamination and, if leaks and/or spills from the Service Station are identified, to determine their areal extent.

In theory, when an underground motor fuel tank or pipeline experience mechanical integrity failure and release occurs, hydrocarbons are expected to move downward in the direction of the water table and then carried in the upper part of the shallowest aquifer in the direction of ground water flow, therefore, contaminating soils along its pathway due to capillary action of soil matrix (figure 1.3.1). Soils containing motor fuel components will yield when analyzed high values of total hydrocarbons, benzene, toluene, ethyl-benzene and xylenes when soil vapor is extracted from soils stratas underneath and around



 Vapor movement from zones of soil and ground water containing hydrocarbons

**SCHEMATIC ILLUSTRATION SHOWING SUBSURFACE VAPOR AND  
HYDROCARBONS RESULTING FROM A PRODUCT RELEASE**

(Adapted From: Underground Storage Tank Corrective  
Action Technologies, EPA/625/6-87-015, January 1987)

Figure 1.3.1

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suspected point sources. Relatively high hydrocarbon concentration in soil vapor from the zone above the hydrocarbon plume will often allow for efficient mapping of plume origin and extend by systematically obtaining soil vapor samples and analyzing them for hydrocarbons content.

The proposed soil vapor extraction and analysis to be performed in the Esso Service Station area will:

- o Detect the presence, if any, of total hydrocarbons, benzene, toluene, ethyl-benzene, xylenes, trichloroethylene, tetrachloroethylene, and dichloroethylene contamination in soils.
- o If contamination in soils is present, it will identify and define its nature and extent.

Soil vapor contaminant investigation refers to a method revived by Thomas M. Spittler (EPA Region I Laboratory) from the Oil and Gas Exploration Industry for investigating underground contamination by means of detecting organic vapors. The method involves pumping a small amount of soil vapor out of the ground through a hollow probe driven to a desired depth and analyzing the vapor for the presence of volatile contaminants. The soil vapor analysis is performed in the field so that samples do not have to be packed or shipped also, analytical results are available immediately and can be used to help direct the investigation. The investigation is usually carried out by analyzing soil vapors in 50'-100' center transects across the suspected contaminated area until boundaries are well defined. The Soil Vapor Investigation Plan has been prepared in consonance with "Spittler



Method". Please refer to section 2.3 of the QA/QC Plan for description of the Sampling Network Design and Rationale.

## 2.0 Statement of Work

In order to determine the range, and spatial distribution of motor fuel that may be present in the soil at the Esso Tutu Service Station, ESSO will implement a two-phase approach which includes the following:

### Phase I

The first phase will consist of soil vapor sampling and analysis on a grid encompassing the Esso Service Station property to determine the presence, if any, of motor fuel contamination in the underlying soils. An extension of Phase I sampling grid will be carried out beyond the Esso Service Station boundaries to determine, if any, the nature of the hydrocarbon plume.

### Phase II

This phase of the investigation will be conducted only if significant hydrocarbon concentrations are found at and around the Tutu station during Phase I. Significant hydrocarbon concentrations will be considered to exist if any of the samples taken exceeds those found in background locations in a factor of three or more.

Additional locations may be sampled based on field judgement and the results of phase I.

The soil vapor sampling program will be terminated at the end of Phase I if it is determined in agreement with USEPA and

Department of Planning and Natural Resources (DPNR) that there is no evidence of motor fuel at the soils underneath the Service Station, or at the end of Phase II if it is determined that motor fuel contamination found on site immigrated from other sources outside the Esso Service Station property.

The work which ESSO proposes to perform is described in Section 3 of this Work Plan. The results of Phase I will trigger and influence the need for the other phases of this investigation.

### 3.0 Technical Approach

The technical approach for this project has been developed with significant input from EPA and CDM-FPC and various site visits performed by ESSO and BAI Representatives during the September-December 1987 period. The proposed study is divided into various tasks in order to provide check points at which progress and findings will be examined, therefore, allowing flexibility for field decisions as to necessity for implementation of subsequent task phases.

The technical approach has been divided into nine tasks. Through these tasks a Work Plan has been developed to conduct a soil vapor sampling grid. Soil vapor samples will be analyzed on site for the following parameters:

- o Total Hydrocarbons
- o Benzene
- o Toluene
- o Ethyl-benzene
- o Xylene

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- o Trichloroethylene
- o Tetrachloroethylene
- o Dichloroethylene

The three chlorinated hydrocarbon compounds, although not typically found on motor fuels, will be analyzed following suggestions from DPNR and EPA. Based on results from previous phases of the program, further soil vapor samples and analysis for the same parameters may be conducted as needed. A final report will be prepared describing and illustrating the results of the study.

The tasks to be performed under the Work Plan do not encompass permit requirements under federal and local environmental laws and regulations. There are no requirements under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the Resource Conservation and Recovery Act (RCRA), or any other environmental law or regulation, either federal or local, applicable to the endeavors covered under the Work Plan.

Occupational Safety and Health Standards found in 29 CFR 1910 are applicable to this project. The Health and Safety Plan submitted herewith addresses the minimum safety procedures that will be followed during the performance of all the tasks involved

in this Work Plan. The nine tasks are presented below:

- Task 01 Site History (completed)
- Task 02 Work Plan Development (completed)
- Task 03 Management Coordination (on going)
- Task 04 Preliminary Site Investigation (completed)
- Task 05 Quality Assurance Project Plan Preparation (completed)
- Task 06 Soil Vapor Sampling and Analysis
- Task 07 Data Analysis and Interpretation
- Task 08 Preparation of Illustrations and Technical Report
- Task 09 Quality Assurance/Quality Control

To successfully carry out this Work Plan within the estimated scheduled time frame, the Esso Project Manager, the BAI Project Officer, and DPNR/EPA designated Field Representatives will maintain the necessary communication to assure that efforts are coordinated and each task is completed according to the Work Plan. Any necessary field changes or corrections in strategies will be examined carefully, and will be documented and coordinated with ESSO and approved by DPNR/EPA Field Representatives.

### 3.1 Task 01 Site History

The Esso Service Station located at the parking lot of the Four Winds Shopping Center, Road 38 in the Tutu neighborhood of St. Thomas, U.S. Virgin Islands, initiated operations during 1970. The Service Station is equipped with two (2) underground fuel storage tanks of 6,000 gallon each. The Service Station as

well as the necessary equipment and appurtenances for its operation, such as the underground tanks and the gasoline pumps, are owned by Esso Standard Oil S.A. Limited, a Bahama corporation organized under the laws of Bahamas.

Mr. Robert Duns, the Service Station first dealer, operated the station from 1970 through 1971, when Mr. Daniel Bayard took over its operation as Esso's new dealer and lessee. Daniel D. Bayard, Jr., the service station current dealer, assumed full management responsibility of the Esso Service Station in March 1976 when his father, the previous dealer, went into retirement.

Of the maintenance activities that have been conducted at the Service Station throughout the years, only two (2), the replacement of piping and an integrity test, may have a bearing on the project.

The 2" pipes connecting the dispensing units to the underground storage tanks were replaced from galvanized to fiberglass during 1985-1987. The replacement job was conducted by Mr. Eugenio de Arce, Esso's St. Thomas maintenance contractor.

One of the two underground storage tanks was emptied and removed from service on July 27, 1987, after the results of a Petro-Tite tank test performed by Roque Schmidt Corp. (see Appendix B for test results) caused Esso to question the structural integrity of the tank. The tank has remained empty ever since, pursuant to an order issued by the Department of Planning and Natural Resources of the U.S. Virgin Islands dated August 21, 1987. A physical examination of the tank has been

unable to be performed pending DPNR authorization.

### 3.2 Task 02 Work Plan Development

The proposed Work Plan has been developed from:

- o Series of meetings between ESSO and BAI Representatives at the site to evaluate physical condition that may restrain the technical approach.
- o Meetings and telephone conversations between ESSO, BAI, DPNR, EPA, and CDM-FPC personnel to establish the basic guidelines and objectives for the proposed study.

The deliverable for Task 01 is this Work Plan. The Work Plan may be adjusted as appropriate at the end of each phase with concurrence and approval by DPNR and EPA pending its outcome.

### 3.3 Task 03 Management and Coordination

The BAI Project Officer will coordinate the technical execution of work tasks described on this Work Plan. The overall Project Management will be performed by Esso Project Manager.

The following is a list of activities to be performed under this task:

- o Provide assurance that team staff and resources are provided so that each task is completed on schedule,
- o initiate approved changes to the Work Plan as necessary,
- o ensure that Quality Control and Quality Assurance measures are monitored and implemented.
- o provide assurance that field personnel will adhere to Health and Safety Plan.

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### 3.4 Task 04 Preliminary Site Investigation

A preliminary site investigation has been performed during the months of September thru December 1987 to allow for optimization of resources during soil vapor extraction and testing operation by identifying in advance the limitation imposed by local conditions, ie. topographic, geologic, construction, structures. This work plan is partially based on site specific requirements based on the results of the preliminary site investigation, as follows:

- o The area is mostly covered with concrete or asphalt and fill material above rocky soil which may limit the soil vapor probe depth of penetration .
- o Establishment of the sampling grid is affected by numerous existing structures. , Offset of grid points may be necessary to provide areal coverage. Sampling grid may be extended based on field judgment.
- o Access authorization from third parties will be required to establish sampling points outside the Service Station, if necessary.

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### 3.5 Task 05 Preparation of Quality Assurance/Quality Control Plan

The attached QA/QC Plan is a documentary record detailing the sampling methodology, QA/QC procedures, data presentation and evaluation techniques to be followed during the field data collection, analysis and report preparation phases of this Work Plan. The QA/QC is based on the requirements outlined in the interim guidelines and specifications for preparing Quality Assurance Project Plans EPA-600/4-83-004, February 1983 publication.

### 3.6 Soil Vapor Sampling and Analysis

The proposed soil vapor sampling and analysis program consists of a two-phase approach where the need for subsequent work will be established by the results of phase I and field judgment.

Soil vapor samples will be collected by driving a 5/8 inch diameter hollow stainless steel probe to the appropriate depth by hand or with a pneumatic driver. After desired depth is achieved, 5 to 10 liters of soil vapor from around the shield point will be extracted with the use of a 500cc/min battery operated vacuum pump attached to the probe with a vacuum gauge and a septum sampling port via a teflon hose. A gas tight syringe will be inserted through the septum port to collect a 2 micrograms to 10 milliliters vapor sample for immediate on site analysis (see figure 3.6.1).

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During all phases of work, soil vapor samples will be analyzed using gas chromatographs owned and operated by BAI (See section 6 and 7 of AQ/QC Plan). Two gas chromatographs equipped with flame ionization detectors (FID) will be used to identify total hydrocarbons and chlorinated hydrocarbons. Analysis to be made at each sample point will consist of:

- o Total hydrocarbons
- o Benzene
- o Toluene
- o Ethyl-Benzene
- o Xylene
- o Trichloroethylene
- o Tetrachloroethylene
- o Dichloroethylene

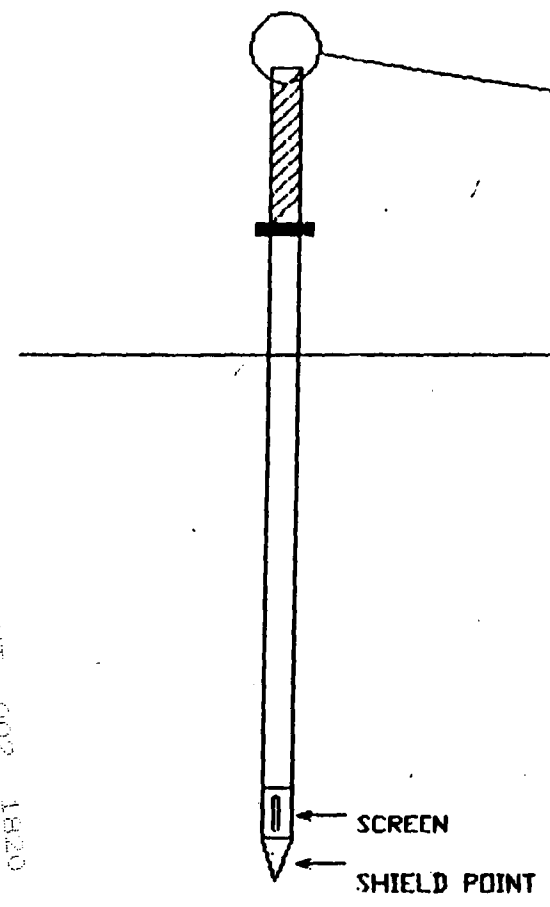
The two proposed phases of work to be conducted at the Esso Service Station area are as follows:

Phase I

Phase I consists of soil vapor sampling on the Esso Service Station property. Sampling points will be spaced in a grid

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WELL POINT SAMPLING

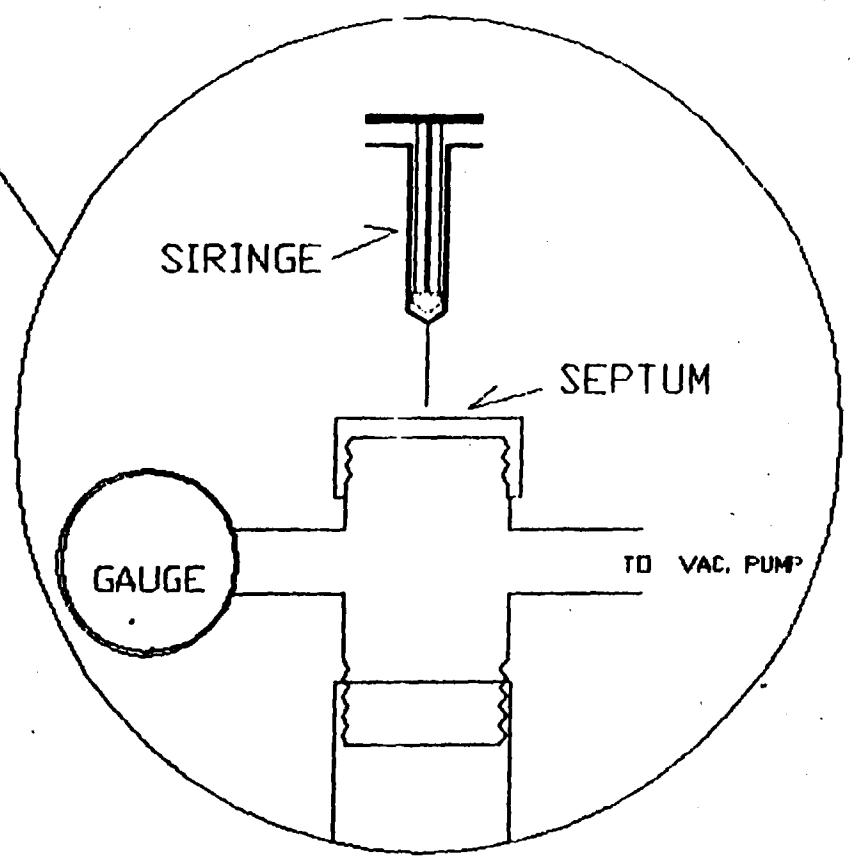


FIGURE 3.6.1

SOIL VAPOR  
SAMPLING PROCEDURE

BELGODERE & ASSOCIATES  
ENVIRONMENTAL-GEED CONSULTANTS

pattern approximately 50 ft centers (figures 3.6.2 a, b). Additionally, at least two background sample points based on field judgement will be taken upgradient or downgradient. A natural drift point should be established based on field judgement to note any significant change in soil vapor values on a day to day basis.

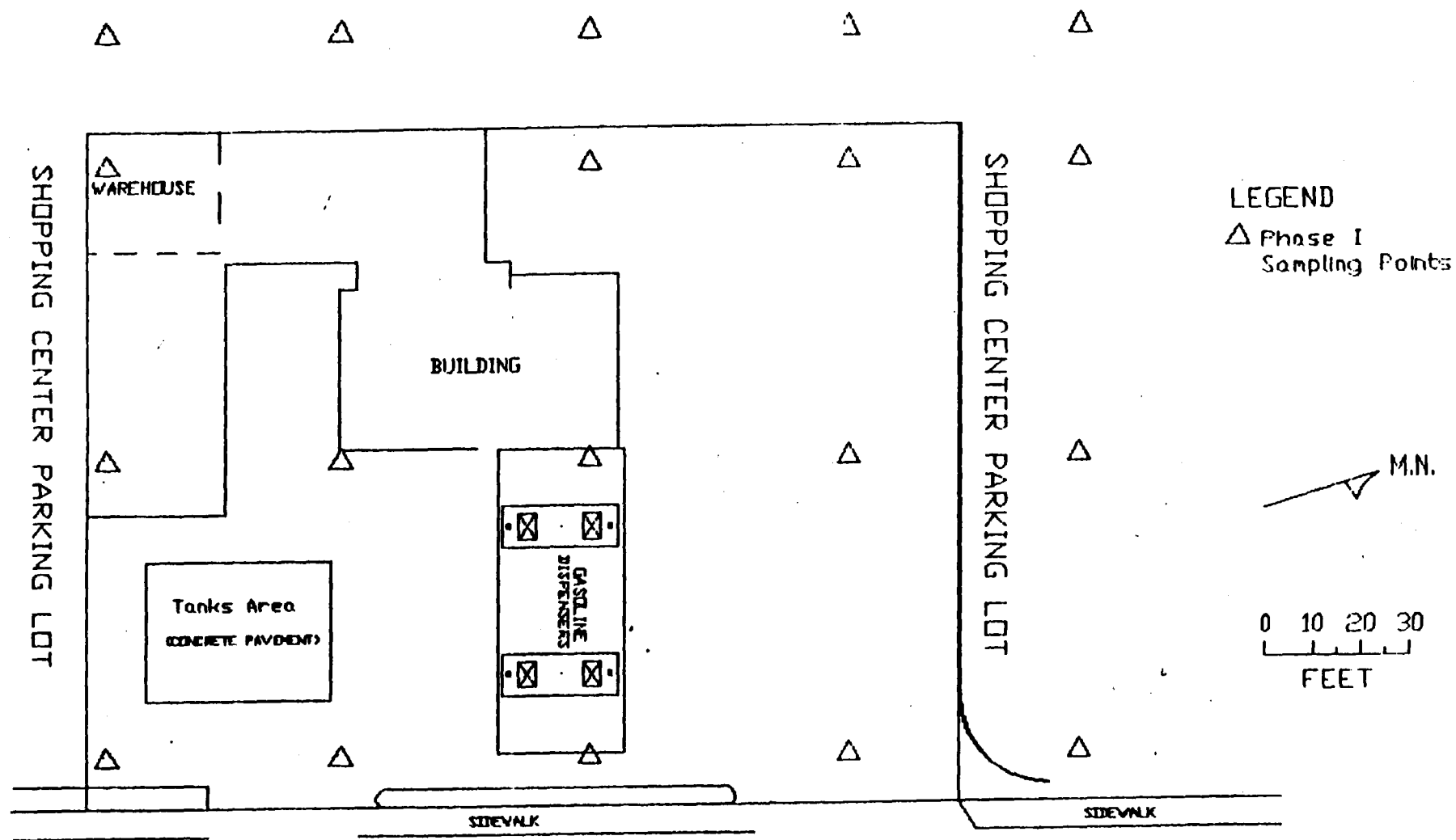
The second phase of this investigation will be conducted if the following criteria is met during the first phase:

- o values of hydrocarbons detected on the station property exceed those found in background locations by a factor of three or more, or based on field judgement.

If Phase II is required, Phase II will extend the grid pattern on a 50, 100, or 200 ft. center as considered appropriate to determine if hydrocarbon contamination generated at the site or immigrated from other sources. Intermediate points in the grid will be established as necessary for adequate plume definition based on field judgement.

#### Phase II

If soil contamination is found to have originated at the Service Station, a further extension of the sampling grid will be

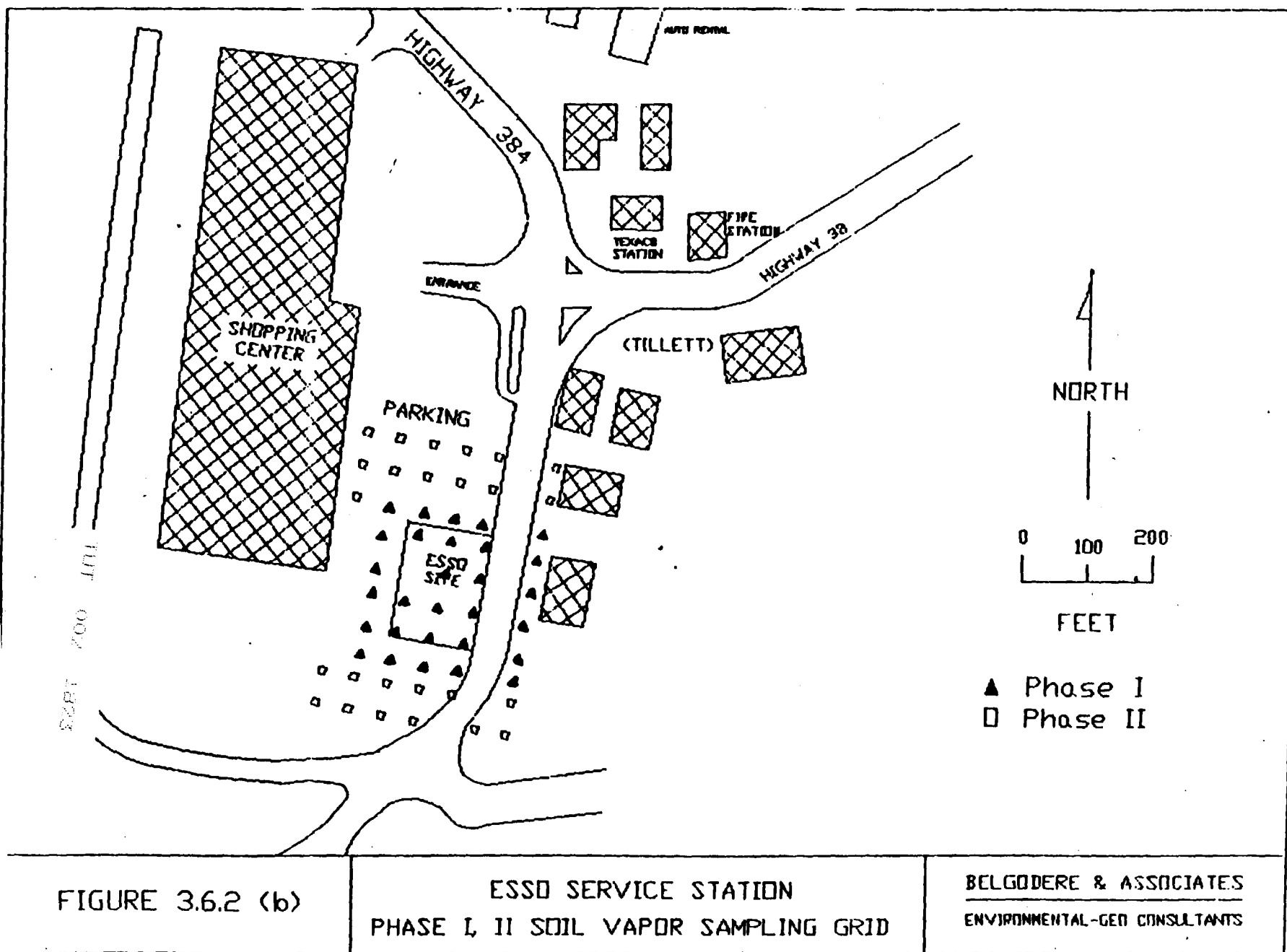


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FIGURE 3.6.2

ESSO SERVICE STATION  
PHASE I SOIL VAPOR SAMPLING GRID

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ENVIRONMENTAL-GEOTECHNICAL CONSULTANTS



carried out to define the areal extent of motor fuel contamination plume in soils above ground water.

The soil vapor sampling program will be terminated in agreement with DFNR and USEPA at the end of Phase I if it is determined that there is no evidence of motor fuel at the soils underneath the Service Station, or at the end of Phase II if it is determined that motor fuel contamination found on site immigrated from other sources outside the Esso Service Station property.

### 3.7 Task 07 Data Analysis and Interpretation

Data analysis and interpretation will be performed simultaneously with the field work to allow changes in field work to properly orientate, extend or reduce the sampling grid based upon results of previously sampling and analysis. Initial data reduction and mapping of soil vapor concentration will be performed at BAI, St. Thomas office.

### 3.8 Task 08 Preparations and Illustrations of Technical Report

After completion of the site investigation described under task 03 through 07, BAI will prepare a final report discussing the results of the investigation. The final report will include, as a minimum, a tabular presentation of the soil vapor analysis values encountered during the course of the investigation (ie. total hydrocarbons, benzene, toluene, ethyl-benzene, xylenes, trichloroethylene, tetrachloroethylene, and dichloroethylene) illustrating the spacial orientation of measured values.

Specific items to be included in the report are:

- o Base map showing distribution of soil vapor sampling points;
- o contour maps of hydrocarbon values to delineate hydrocarbon plumes and possible trajectory;
- o tables listing all soil vapor hydrocarbon values encountered during the course of this investigation;
- o maps showing relationship of hydrocarbons values in soil vapors to estimate ground water flow direction on local geology;
- o GC Chromatograms;
- o conclusions and recommendations.

### 3.9 Task 09 Quality Assurance and Quality Control

QA Officer for this project, Eng. Omar Munir has reviewed this work plan for QA requirements and will maintain QA oversight through the duration of this project. BAI work on this assignment will be conducted in accordance with project specific QA/QC which is being submitted with this Work Plan.

### 4.0 Performance Schedule and Schedule of Deliverable

A site investigation plan schedule is shown in figure 4.0.1 and the deliverable date schedule is included on figure 4.0.2.

The project schedule depends upon initiation of field work on April 4, 1988. Approval of the Work Plan and Quality Assurance, Quality Control Plan one week before that date will be necessary to assure timely completion of the project.

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Figure 4.0.1

SITE INVESTIGATION SCHEDULE

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Work Plan Development.....Dec. 2 to Dec. 28, 1987

Review Approval.....Jan. 25 to Feb. 1, 1988

Soil Vapor/Field Investigation.....Apr. 4 to May 4, 1988

Data Evaluation.....May 4 to May 18, 1988

Final Report.....May 18 to Jun. 1, 1988



Figure 4.0.2

DELIVERABLE SCHEDULE

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Project Deliverable -----	Initial Text to DFNR/EPA -----	Receipt of Technical Comments -----	Final -----
1. Work Plan	12/28/87	1/25/88	2/1/88
2. QA/QC	12/28/87	1/25/88	2/1/88
3. Health & Safety Plan	12/28/87	1/25/88	2/1/88
4. Final Report	6/01/88	N/A	N/A